this when the temperature is constant, agrees with the above expression if $p = q = r = s$.

We see that the state of equilibrium will vary rapidly with the temperature if H be large, that is, if the chemical process is attended by the evolution of a large quantity of heat.

The effect of alterations in the external circumstances such as those which may be produced by capillarity, pressure, or electrification are investigated, and it is shown that anything giving rise to potential energy which increases as the chemical combination goes on tends to stop the combination.

The last part of the paper is taken up with the consideration of irreversible effects such as those accompanying the passage of electric currents through metallic conductors or electrolytes. These are looked upon as the average of a large number of discontinuous phenomena which succeed each other with great rapidity. The ordinary electrical equations with the usual resistance terms in, represent on this view the average state of the system, but give no direct information about its state at any particular instant. It is shown that if we take this view we can apply dynamical principles to these irreversible effects, and the results of this application to the case of electrical resistance are given in the paper.

V. " Conduction of Heat in Liquids." By C. CHREE, B.A., King's College, Cambridge. Communicated by Professor J. J. THOMSON, F.R.S. Received March 31, 1887.

(Abstract.)

In this research the liquid layer through which the conduction takes place is of a moderate thickness, the object being to obtain results not open to the objections which can be raised against most previous methods, in which conduction has taken place through layers of very small thickness.

Two similar forms of apparatus, differing chiefly in size, were employed, but from the larger apparatus few results were obtained, and to these little independent weight is assigned.

The liquid was contained in a wooden tub, and heat was applied by pouring hot water into a metal dish supported so as to be in contact with the liquid surface. At a given depth was fixed a fine platinum wire, and the variation in its temperature was determined by observing the variation in its electrical resistance. By this means the temperature at a given depth in the liquid is determined for any instant subsequent to the application of heat.

In applying the heat a given quantity of water, heated to a given

temperature, was suddenly poured into the metal dish, and the time noted. In one set of experiments this water was after a given interval siphoned from the dish, in another set it was left undisturbed. In either case the variation in the temperature of the platinum wire, as indicated by the change in its resistance, was determined by observations of the readings of a delicate galvanometer, which was affected by the variation in an electrical current traversing the platinum wire. The galvanometer readings supplied data from which could be calculated the interval that elapsed after the application of heat before the temperature in the liquid surrounding the platinum wire was rising fastest. An independent series of experiments gave the rate at which heat passed into each liquid from the dish.

To calculate the conductivity a mathematical investigation is carried out, which leads to an equation connecting the conductivity, density, and specific heat of a liquid with the time elapsed after the application of heat at the surface before the heating at a given depth should be most rapid. Though this equation cannot be directly solved, solutions of a close degree of approximation can be obtained. The density and specific heat being known, these solutions enable the conductivity to be calculated in absolute measure.

The liquids examined were water, paraffin and turpentine oils, bisulphide of carbon, methylated spirit, and solutions of various strengths of sulphuric acid and water. In the case of paraffin oil, methylated spirit, and water, the two different methods were employed, and the results agreed fairly well. In the case of turpentine the water was never siphoned, and in the case of the remaining liquids the siphon was always used. It was found that the conductivity of the various sulphuric acid solutions, some of considerable strength, differed very slightly from that of water, and thus there is a marked distinction between conducting powers for heat and for electricity. The presence of small impurities in the liquids, such as small quantities of salt, had no appreciable effect on the conductivity.

The intervals that elapsed after the application of heat before the temperature at the given depth was rising fastest did not differ very largely for the various liquids. It was shortest for the bisulphide and longest for turpentine. Owing to the comparatively small variation in this interval the value of the conductivity depends largely on the product of the density into the specific heat, a quantity to which it is directly proportional.

The values actually obtained are the following :—In those under column 1 the water was siphoned from the dish, in column 2 it was not. The units are centimetre and minute.

Liquid.	Column 1.	Column 2.
Water	0 ·0747	0 ·0815
Solution sulphuric acid, No. 1 ..	0 ·0759	—
,, No. 2 ..	0 ·0767	—
,, No. 3 ..	0 ·0765	—
,, No. 4 ..	0 ·0778	—
Methylated spirit	0 ·0354	0 ·0346
Bisulphide of carbon	0 ·0322	—
Paraffin oil	0 ·0264	0 ·0273
Turpentine oil	—	0 ·0189

The temperature of the various experiments differed somewhat, but as a rule was a little under 20° C. The difference of temperature in the two series of experiments on water tends partly to explain the discrepancy in the above results, as the results of previous observers indicate a considerable rise in conductivity with the temperature. For water and the methylated spirit results of a confirmatory nature were obtained by the larger apparatus.

The experiments were conducted in the Cavendish Laboratory.

Presents, April 21, 1887.

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